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Weather Radar
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This report contains the information necessary to operate the Weather Radar Processor and Display Equipment.

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REPORT

WEATHER RADAR PROCESSOR AND DISPLAY
RADAR INTERFACE ADAPTER
VOLUME II

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TABLE OF CONTENTS

TABLE OF CONTENTS Continued

1.0   INTRODUCTION

The Weather Radar Processor and Display System will accept
digitized echo intensity data from a radar signal integrator and
store this data in a manner that will enable a user to view up
to 40 complete weather presentations. These weather presentations
are displayed in three colors (green, blue and red); each color
for a range of echo intensities as manually set by the user,
with iso-echo blanking for signals above the iso-echo threshold.

1.1   SYSTEM CAPABILITY

1.1.1   Picture Acquisition

The system can acquire a finite number of from one to
forty pictures or can continuously capture pictures. Pictures can
be captured at a rate of from 30 seconds to 10 minutes with a half
second resolution. Angular resolution can be increased by proces-
sing the total number of azimuth sweeps (256) in sector widths of
90° or 180° as well as 360°.

1.1.2   Picture Presentation

Any sequence of previously acquired pictures can be auto-
matically displayed at a rate of from one half second to five
seconds with a half second resolution. This sequence can also
be displayed manually via operator controls rather than auto-

matically. In addition, the automatic time lapse sequence display-
ing can be stopped to display a single picture and then continue
picture presentation either forward or backward in the time sequence.
If previously acquired pictures are not being displayed, newly
acquired pcitures are displayed in real time.

When a picture is displayed, the following information is
also presented:

1. Intensity levels for the three colors and iso-echo blanking
2. Date of picture acquisition
3. Time of picture acquisition
4. Picture identification (i.e., #1 to 40)
5. Time of picture presentation.

1.1.3   Threshold Modification

The threshold intensity levels for each color and the
iso-echo blanking can be changed at any time such that the
amplitude data for any subsequent picture acquisition will be
converted according to these new intensity levels. The user
also has the capability of reconverting any or all of the
previously acquired pictures according to these new intensity
levels. As each picture is converted, it is automatically
displayed.

1.2 SYSTEM SOFTWARE FAMILIARIZATION

The Weather Radar Processor and Display System is a totally integrated system consisting of the Raytheon Real Time Operating System (RTOS) and the Weather Radar Processor and Display Program Software. The Weather Radar Processor and Display System is simply an extension of the RTOS.

1.2.1 Real Time Operating System

The Real Time Operating System for the Raytheon 704 computer is a disc based operating system which permits rapid response to real time events or external requests. Via the RTOS, the user is able to load, execute and communicate with the Weather Radar Processor and Display Program Software. This manual shall limit its discussion to those aspects of the RTOS required for the proper operation of the Weather Radar Processor and display Program Software and to the procedures required for the generation of the Weather Radar Processor and Display System. Further information regarding the RTOS can be obtained from those documents specified in Appendix A.

1.2.2 Weather Radar Processor and Display Program Software

The Weather Radar Processor and Display Program Software consists of the on-line Weather Radar Processor and Display Operational Program (WEATHER) and the Weather Radar Processor and Display Support Programs (PATTERN and CONSTANT). The WEATHER performs the

real-time functions of the system (i.e., picture acquisition, displaying, etc.), whereas PATTERN and CONSTANT perform the necessary off-line functions (i.e., creating display test patterns and the permanent storing of the display refresh constants on disc).

2.0 REAL TIME OPERATING SYSTEM OPERATION

Before Weather System operations can be initiated, the RTOS must be loaded from disc and certain RTOS directives must be issued for system initialization purposes. Once these operations have been performed, anyone of the Weather System programs can be loaded and executed and has returned control to the RTOS, it is not necessary to reload the RTOS and perform system initialization.

2.1 SYSTEM STARTUP

In order to properly turn the system on and off it is necessary to follow the procedures detailed in Figure 2.1-1. Destruction of programs and data stored on the disk unit may result if the procedure is not followed.

2.1.1 BOOTSTRAP LOADING THE RTOS

The RTOS is loaded from disc by depressing:

1) computer RESET

2) disc controller LOAD

3) computer RUN.

The message "REDY" should appear on the teletype indicating that the RTOS has been loaded and is ready to accept directives from the teletype.

FIGURE 2.1-1   TURN ON - TURN OFF PROCEDURE

A. TURN ON:

    1. Press Power ON Switch

    2. Press Computer RESET button

    3. Switch disk switch to RUN position

    4. Follow software procedure.

B. TURN OFF:

    1. Press HALT button on Computer

    2. Press RESTART button on Computer

    3. Switch disk switch to LOAD position

    4. Wait for LOAD indicator to turn on

    5. Press Power OFF switch.

CAUTION: This procedure must be followed to prevent
            inadvertant destruction of programs and
            data stored on the disk unit.

2.2   SYSTEM INITIALIZATION DIRECTIVES

Initialization directives must be issued to:

1) Ensure that the RTOS is set to its standard configuration

2) Set the date

All directives for both the RTOS and the Weather System are issued from the teletype and must start with a line feed and end with a carriage return.

2.2.1   Standard Configuration Directive

This directive is issued by typing ":NJ." After the RTOS has been loaded, this should be the first directive to be issued. After this directive has been issued, the teletype paper should space several lines and the message "NEXT" should appear on the teletype.

2.2.2   Date

The date is set by typing ":DA.XXXXXXY." The six or fewer alphabetic characters are stored into the monitor cells reserved for the date. The input should be of the form :DA,25NOV4. Neither commas nor blanks can be input as part of the date.

3.0   ON-LINE WEATHER PROGRAM SYSTEM OPERATION

This section describes the procedure by which the on-line weather program is executed and the teletype directives which initiate the various functions performed by weather.

3.1   PROGRAM LOADING AND EXECUTION

After the RTOS has been loaded and the various system initialization directives have been issued, the weather is loaded and executed by issuing the following RTXRAY directives:

1)   :QU, WEATHER

2)   :EX

The message "WEATHER IN" should appear on the teletype indicating that WEATHER has been loaded and is ready to accept directives from the teletype.

3.2   WEATHER DIRECTIVES

When WEATHER is loaded, various system operating parameters are pre-set to specified values. Thus, the user need not specify all operating parameters if some of the pre-set values meet his requirements. Figure 3.2.1 is a list of the pre-set values for all operating parameters.

3.2.1   Define Display Sequence - $*D_1$ N_1 N_2 N_3

This directive defines the display picture sequence (but does not initiate picture displaying. That is, pictures N_1 (1-41) to N_2 (1-41) are to be displayed at a rate of N_3 1/2 seconds. This directive may be issued more than once to obtain any sequence desired (e.g., display pictures 10 to 20, 25, 40, and 5), but only 40 pictures may be contained in a sequence. If only one picture is being added to the sequence (e.g., display picture 5), only the first argument (N_1) need be typed in. If the display rate (N_3) is not entered, the rate is defaulted to its previous definition[3] (at load time this is 2.5 seconds). The display rate can be set at any time (even while pictures are being displayed) by setting N_1 and N_2 to 0 (e.g. #D, 0, 0, 5). If N_2 is less than or equal N_1, only picture N_1 is added to the sequence.

Example:

*D, 1, 5   Picture 1 to 5 are added to sequence

*D, 10   Picture 10 is added to sequence

*D, 14, 13   Picture 14 is added to sequence

*D, 15, 0, 10   Picture 15 is added to sequence and
                         display rate is 5 seconds

*D, 0, 0, 5   Display rate is changed to 2.5 seconds

These previous inputs would cause pictures to be displayed in the following sequence:

1, 2, 3, 4, 5, 10, 14, 15

3.2.2 Initiate Displaying - *I,X

This directive starts the automatic display picture sequencing. If a Halt Sequence directive had been previously issued this directive causes the display sequencing to be continued. "X" indicates whether the sequence is to be displayed forward ("F" or blank) or reverse ("R"). Picture displaying is continuous, i.e., after the sequence has been displayed, it is repeated.

3.2.3 Display Next Picture - *N,X

If automatic display picture sequencing is not desired, this directive allows the user to display pictures in the sequence manually rather than automatically. This directive may also be used after a Halt Sequence directive. This directive causes either the next picture of the previous picture in the display picture sequence to be displayed. If "X" is "F" or blank, the next picture in the sequence is displayed. If "X" is "R", the previous picture in the sequence is displayed.

3.2.4 Define Picture Capture - *P, N_1, N_2

This directive defines the number of pictures to be captured and at what rate (but does not initiate picture capture). That is, capture N_1 (1-40) pictures at N_3 1/2 seconds. Unlike the Define Display Sequence directive, this directive may only be issued once (until either 1) all pictures have been captured, or 2) the Terminate Picture Capture directive has been issued, or 3) the Restart directive has been issued). If N_1 and N_2 are left blank, only one picture will be captured. If N_1 is 99, pictures will be captured continuously at the specified rate.

3.2.5 Start Picture Capture - *S

This directive starts the process of 1) capturing one picture, or 2) capturing a finite number of pictures (no more than 40) or 3) capturing pictures continuously (dependent upon the previously entered Define Picture Capture directive).

3.2.6 Define Azimuth - *A, N_1, N_2

This directive defines the azimuth sweep size (N_1) and the starting quadrant (N_2). The azimuth sweep size can have a value of 90, 180 or 360. The starting quadrant argument can be either 0, 90, 180 or 270 (if left blank, 0 is the default value. The valid combinations are:

360	and	0	(or blank)
180	and	0	(or blank)
180	and	180	
90	and	0	(or blank)
90	and	90	
90	and	180	
90	and	270	

3.2.7   Define Color Threshold - *C, N_1, N_2, N_3, N_4

This directive defines the color and iso-echo thresholds. N_1, N_2 and N_3 define the green, blue and red thresholds respectively and can have an integer value from 0 to 63. N_4 defines the iso-echo threshold and can have an integer value from 3 to 64. If N_4 has a value of 64, there is no iso-blanking. Each argument must be greater than the previous (thus, N_4 cannot be less than 3).

3.2.8   Change Threshold Values - *V

This directive causes all pictures that previously had been defined to be displayed (by the Define Display Sequence directive) to have their radar amplitude data converted to new threshold levels (defined by the Define Color Threshold directive). After each picture is converted it is displayed.

3.2.9   Halt Display Sequence - *H

This directive halts the automatic sequence displaying of pictures. The next picture in the sequence will be the last to be displayed until otherwise directed by either the Initiate Displaying directive or the Display Next Picture directive.

3.2.10   Terminate Operation - *T,X

This directive causes the termination of any operation that had been initiated. The valid character values of "X" and their results are:

1) "D" - Picture displaying is stopped after the next picture is displayed (if pictures are being displayed). There are no longer any pictures defined for the display picture sequence but the display rate is retained.

2) "P" - Picture capture is terminated at the next picture capture initiation cycle. The number of pictures to be captured is cleared but not the picture capture rate.

3) "V" - Threshold changing of previously captured pictures is terminated after the next picture in the picture display sequence is converted.

3.2.11   Restart - *R

This causes all system operations to cease (i.e. picture capturing, picture displaying and threshold changing). All system operation parameters (number of pictures to be captured, sequence of pictures to be displayed, etc.) is preserved, but the disk data base is re-initialized (that is, all 40 pictures will contain the test pattern - picture number 41).

3.2.12   Logout - *L

This directive causes the error message contained in the Error Logout Table to be printed on the TTY.

3.2.13   Dump Core - *Y, N_1, N_2

This causes the contents of memory locations N_1 to N_2 to be printed in hexadecimal on the TTY.

3.2.14   Enter Core - *Z, N_1, N_2

This directive causes the contents of memory location N_1 to be replaced with the hexadecimal number N_2.

3.2.15   Exit - *X

This directive causes the weather to transfer control to RJXRAY.

3.2.16   Set Time - *M, HHMM

This directive sets and starts the time of day clock.

3.2.17   Continue Picture Capture - *Z,671,A00

Entering this directive causes picture capture to continue from the last capture instead of starting at Number 1 each time a capture directive is issued.

3.3   OPERATING NOTES

3.3.1   General

1. Picture displaying cannot be initiated (via the *I directive) if no pictures have been defined for the picture display sequence (*D directive) except at load time.

2. Once picture displaying has been initiated, pictures can be added to the picture display sequence as well as change the display rate. If the display rate is changed, pictures will be displayed at the new rate after the next picture is displayed.

3. Although only 40 pictures can be contained in the
   picture display sequence, the user can specify that
   more than 40 pictures be displayed. After the first
   40 pictures have been specified, all further pictures
   specified will replace those in the beginning of the
   sequence. For example, if the user specifies picture
   1 to 40 be displayed and then specifies pictures 5 and
   7 be displayed, the actual picture display sequence
   would be:

$$5, 7, 3, 4, \ldots\ldots, 40$$

4. Picture displaying cannot be initiated if system is
   performing threshold changing.

5. The halt directive can only be issued if the system
   is performing automatic picture displaying.

3.3.2   Picture Capturing

1. Picture capturing cannot be initiated (*S directive)
   if the number of pictures to be captured has not
   been specified (except at load time).

2. After a picture is captured and converted it is dis-
   played if the system is not performing picture
   displaying (automatic or manual) or threshold changing.

3.3.3   Threshold Changing

1. Threshold changing cannot be initiated if there are no pictures defined for the picture display sequence (*D directive) except at load time. It cannot be initiated if the system is performing automatic picture displaying but can be initiated if the system is performing manual picture displaying. If threshold changing is to be performed the Halt directive must first be issued.

2. After each picture is converted, it is displayed.

4.0 WEATHER RADAR PROCESSOR AND DISPLAY SUPPORT SOFTWARE OPERATION

The Weather Radar Processor and Display Support Software consists of the two programs PATTERN and CONSTANT. These two programs are maintained on disc as part of the Weather System and are loaded and executed via the RTOS.

4.1 PATTERN OPERATION

PATTERN's function is to create a series of test patterns on disc that can later be displayed via the WEATHER program. These test patterns are defined in Appendix B. 41 test patterns are generated. The first 40 test patterns are stored on the disc area that is reserved for picture acquisition. The 41st test pattern is the test pattern that can be displayed while WEATHER is performing on-line system operations (i.e., picture acquisition, picture displaying, etc.). The user has the capability of specifying the azimuth sweep size and starting quadrant of the test patterns.

PATTERN is loaded and executed by issuing the following RTOS directions:

: QU, PATTERN

: EX

The following message should appear on the teletype:

TYPE IN	FOR	AZIMUTH SWEEP	STARTING QUADRANT
0		360	0
1		180	0
2		180	180
3		90	0
4		90	90
5		90	180
6		90	270

If a character is typed in other than as number from 0 to 6, the above message is typed out again. Otherwise, PATTERN begins the process of generating the 41 test patterns. After the test patterns have been generated, the message "REDY" should appear on the teletype indicating that the RTOS is ready to accept further directives. At this time WEATHER could be executed to display the test patterns.

4.2 CONSTANT OPERATION

CONSTANT's function is to read the paper tape containing the display refresh constants and store these constants on disk. Generation of this paper tape is described in Appendix C. CONSTANT is normally operated at system generation time. But in the event that the disc area where the constants are stored is destroyed, CONSTANT can be called upon to restore the constants on disc. After the constants have been stored on disc, CONSTANT transfers these constants to the RAM of the display controller. Whenever

WEATHER is executed, it transfers the constants from disc to the RAM of the display controller.

The CONSTANTS are loaded and executed by issuing the following RTOS directives:

```
    :  QU, CONSTANT


    :  EX
```

The PTR indicator on the teletype should light up indicating that CONSTANT has been loaded and is ready to read the paper tape. The paper tape should then be placed in the paper tape reader and the paper tape reader started. After the paper tape has been read (approximately 40 minutes) and the constants have been transferred to the disc (by depressing the 704 run button) and to the RAM of the display, the message "REDY" should appear on the teletype indicating that the RTOS is ready to accept further directives.